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Yoon et al.

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(54) **MULTI WIRELESS CHARGING APPARATUS AND METHOD FOR MANUFACTURING THE SAME**

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H02J 7/02	(2006.01)
H02J 5/00	(2006.01)
H01F 38/14	(2006.01)

(52) **U.S. Cl.**
CPC ***H02J 7/00*** (2013.01); ***H02J 7/0042*** (2013.01); ***H02J 7/025*** (2013.01); *H01F 38/14* (2013.01); *H02J 5/005* (2013.01); *Y10T 156/1002* (2015.01)

(58) **Field of Classification Search**
CPC H01F 38/14; H02J 5/005; H02J 7/00; H02J 7/0042; H02J 7/025; Y10T 156/1002
See application file for complete search history.

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(57) **ABSTRACT**

Disclosed herein are a multi wireless charging apparatus and a method for manufacturing the same. The multi wireless charging apparatus includes: a control unit wholly controlling a multi wireless charging process; and a plurality of wireless charging units electrically connected with the control and deformed into a roll form by being bonded so as to a plurality of interlayer voids at the time of laminating a plurality of flexible substrates. By this configuration, the multi wireless charging apparatus can be rolled up in a roll form while having a slim thickness and therefore, can be conveniently carried.

17 Claims, 10 Drawing Sheets

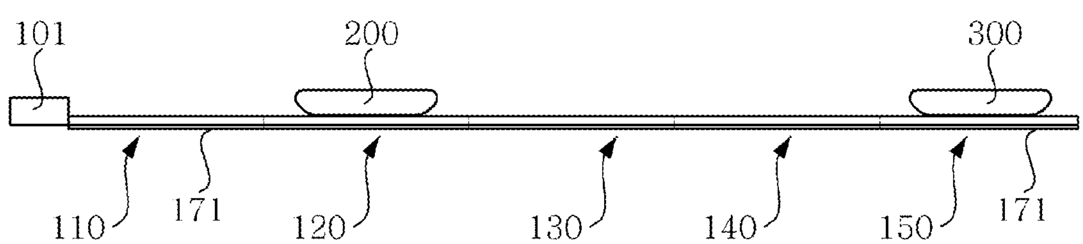


FIG.1A

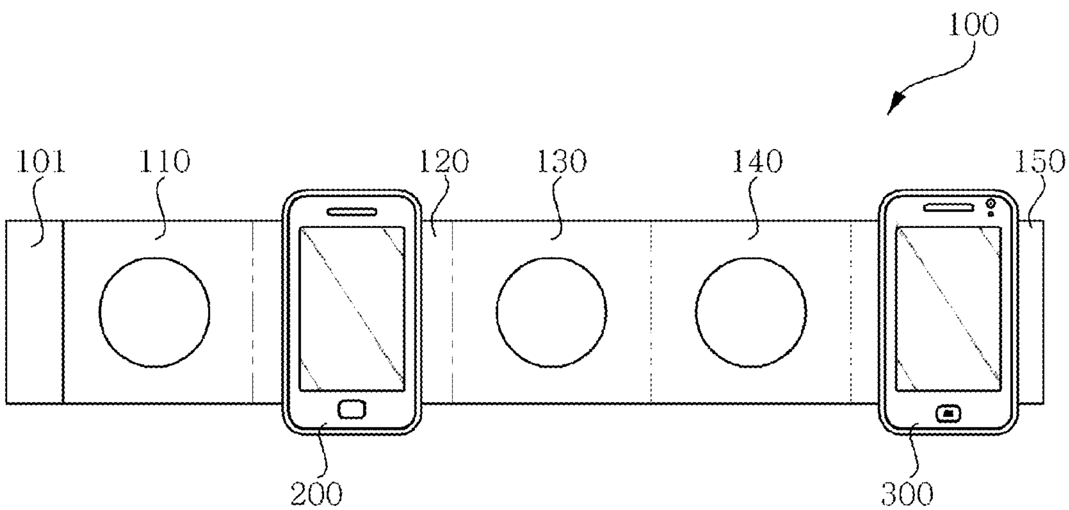

100
101
110
120
130
140
150
200
300

FIG.1B

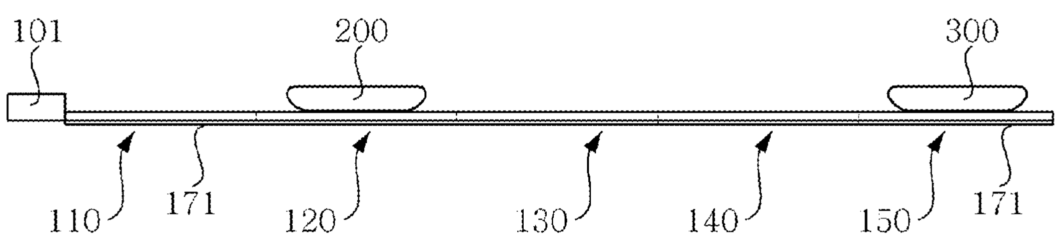

101
200
300
110
171
120
130
140
150
171

FIG.2

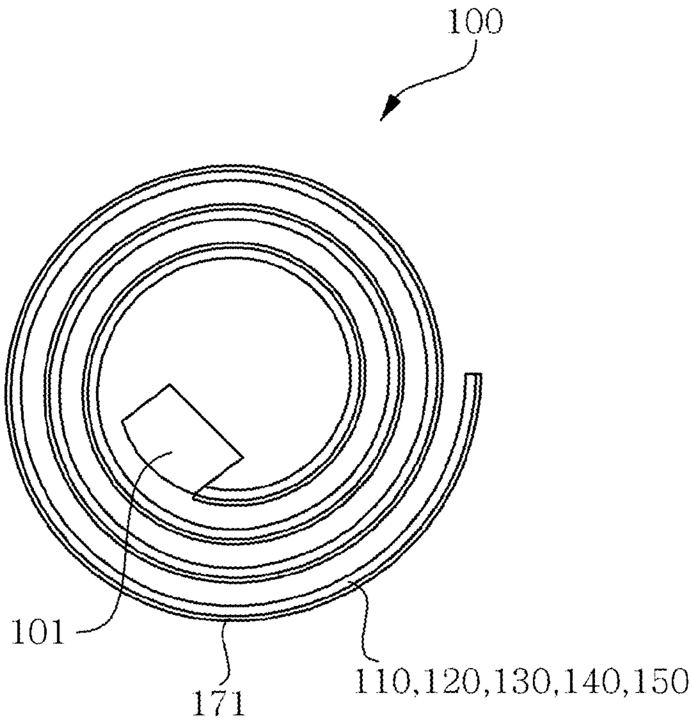


FIG.3A

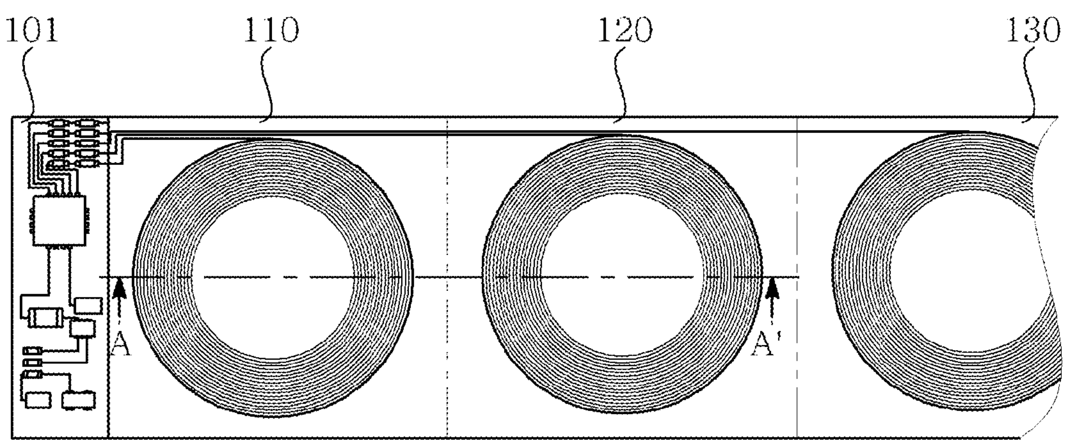


FIG. 3B

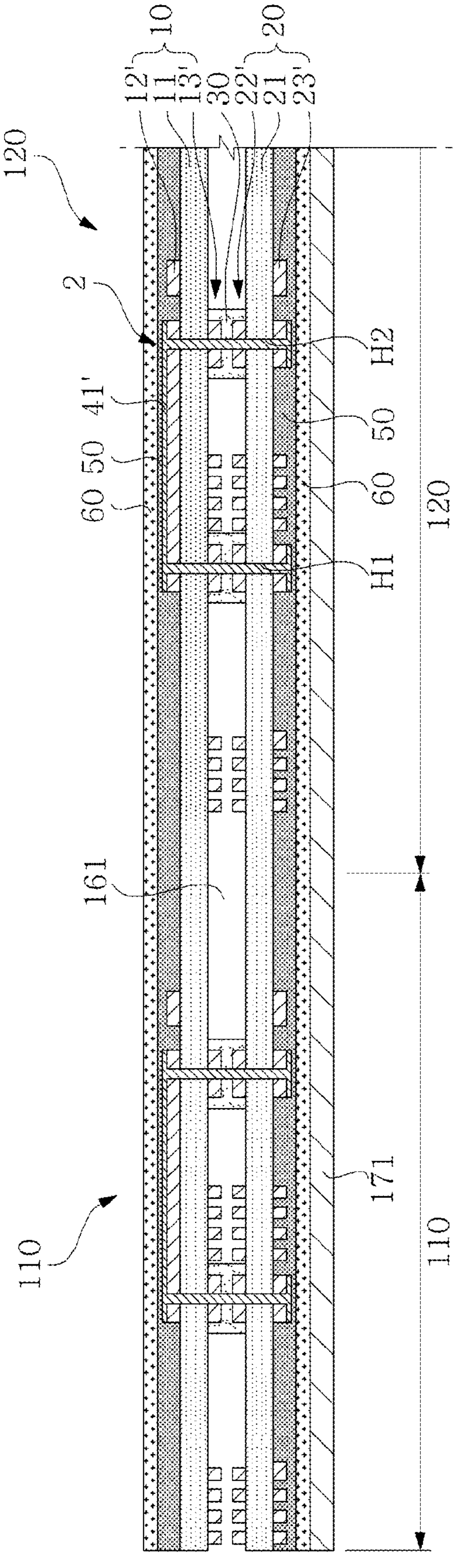

10
20
12'
11
13'
30
22'
21
23'
120
2
H2
41'
50
60
50
60
120
H1
161
171
110
110

FIG. 4A

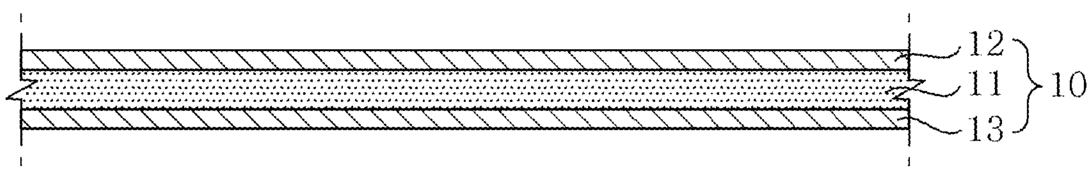


FIG. 4B

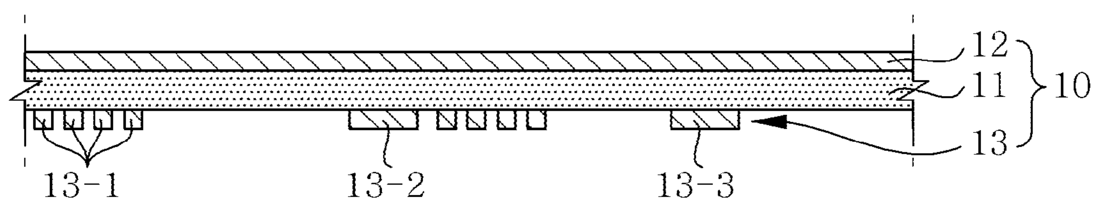


FIG. 4C

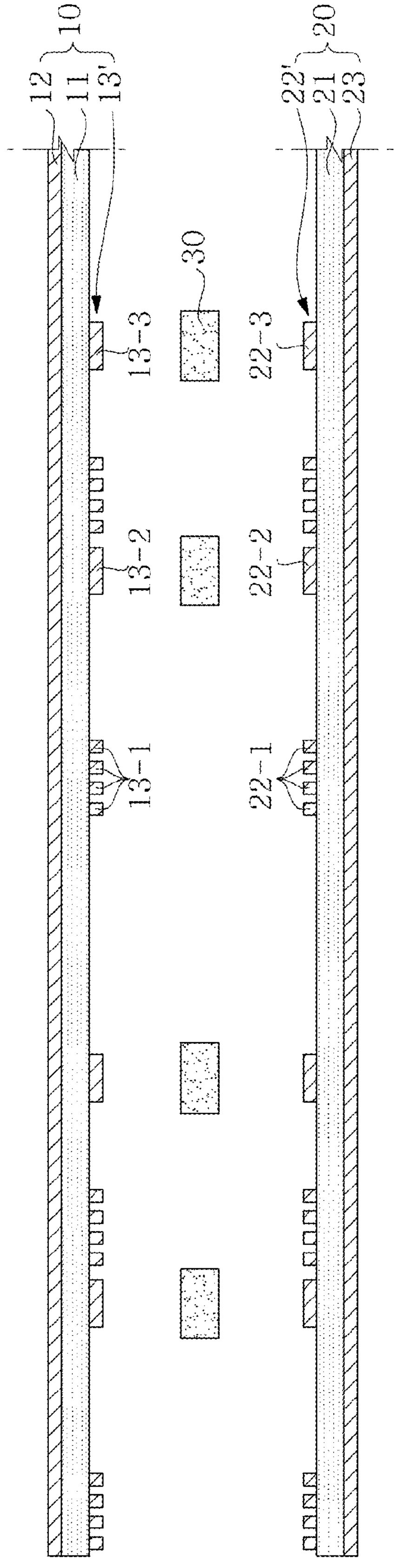


FIG. 4D

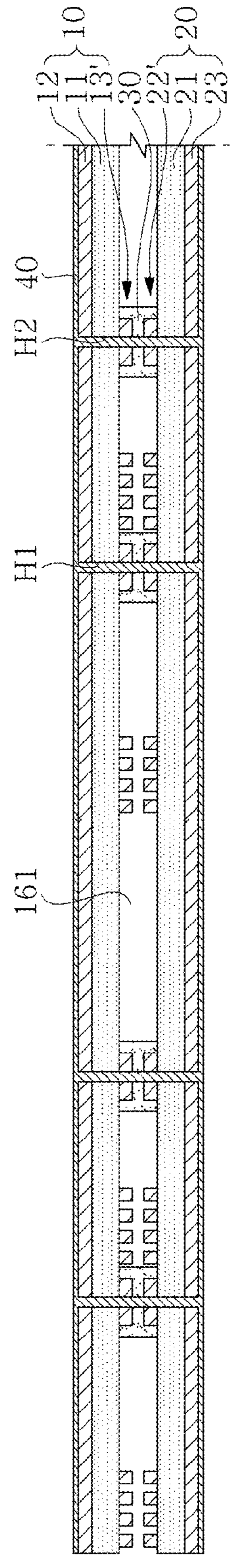


FIG. 4E

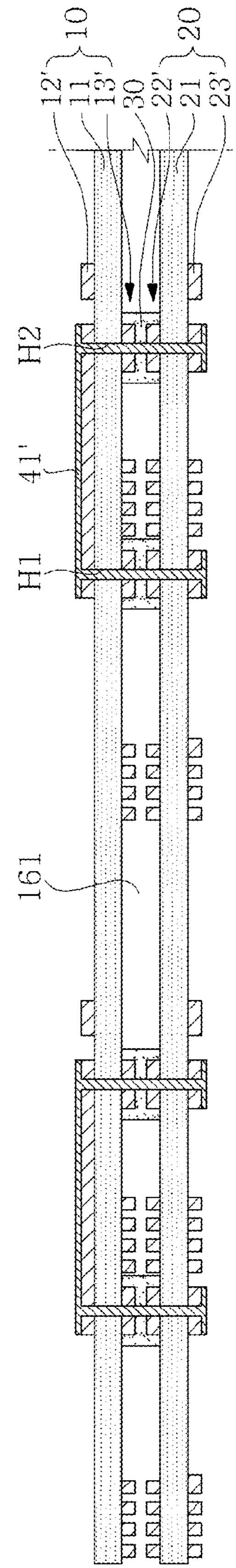
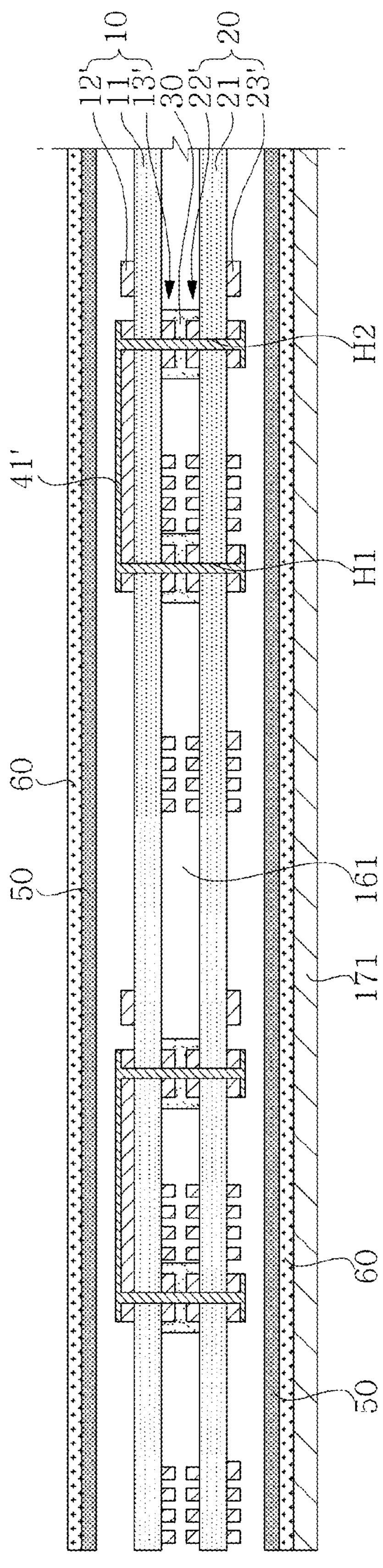


FIG. 4F



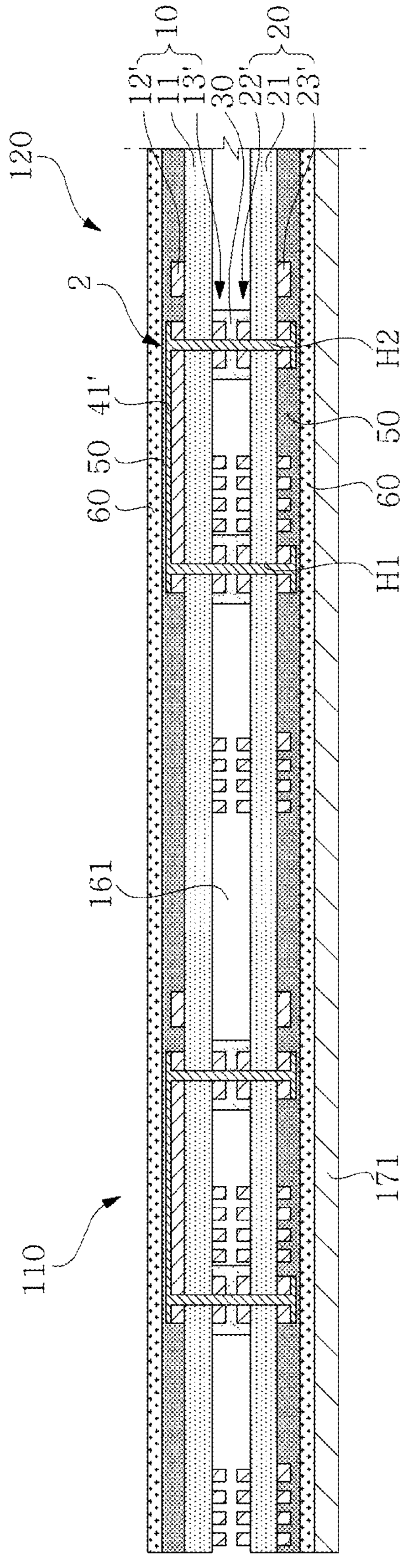
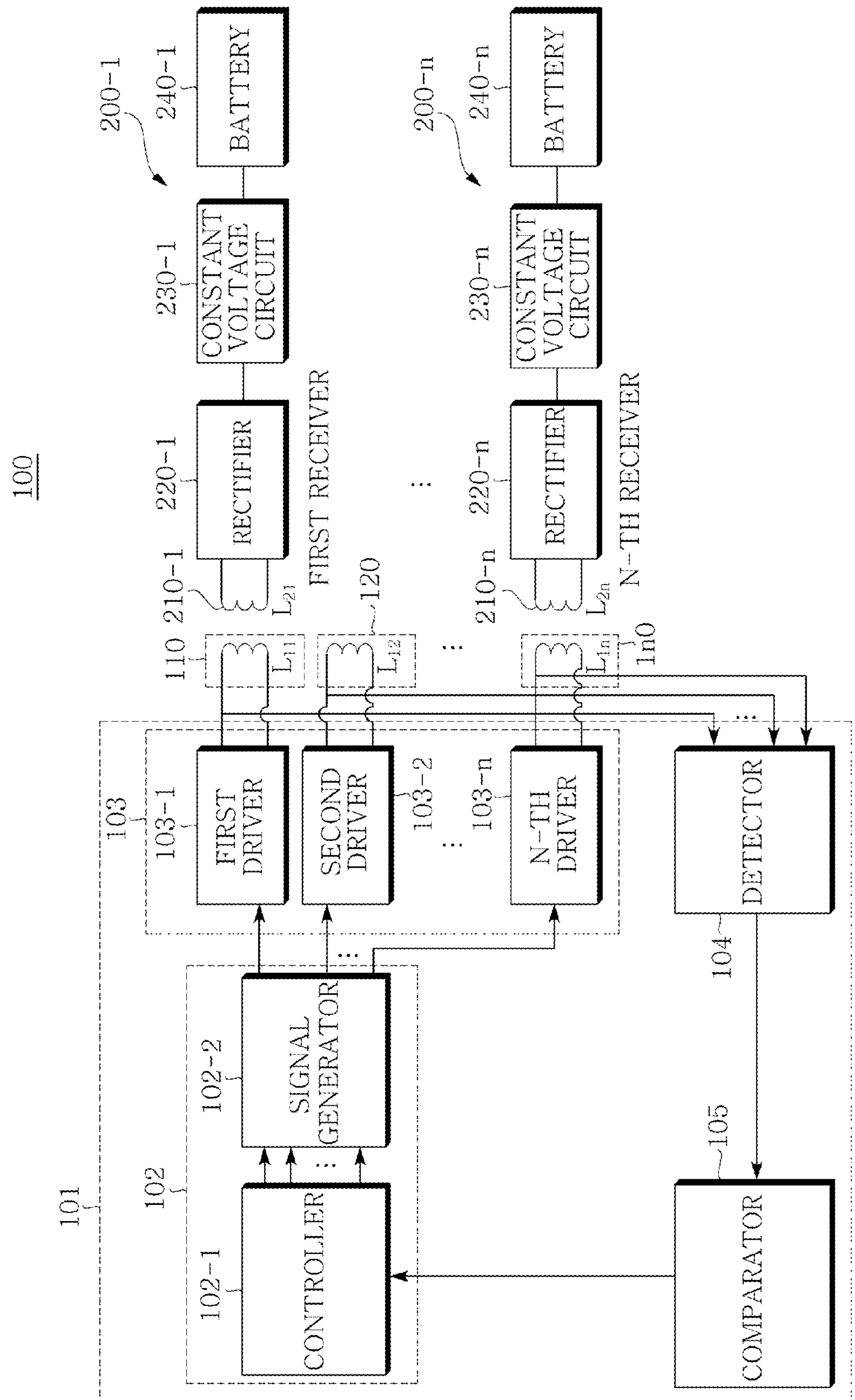


FIG. 4G

FIG. 5


100
200-1
240-1
BATTERY
230-1
CONSTANT VOLTAGE CIRCUIT
220-1
RECTIFIER
210-1
L_{21}
FIRST RECEIVER
200-n
240-n
BATTERY
230-n
CONSTANT VOLTAGE CIRCUIT
220-n
RECTIFIER
210-n
L_{2n}
N-TH RECEIVER
110
L_{11}
120
L_{12}
1n0
L_{1n}
101
102
102-1
CONTROLLER
102-2
SIGNAL GENERATOR
103
103-1
FIRST DRIVER
103-2
SECOND DRIVER
103-n
N-TH DRIVER
104
DETECTOR
105
COMPARATOR

MULTI WIRELESS CHARGING APPARATUS AND METHOD FOR MANUFACTURING THE SAME

CROSS REFERENCE TO RELATED APPLICATION

This application claims the benefit of Korean Patent Application No. 10-2011-0146826, filed on Dec. 30, 2011, entitled "Multi Wireless Charging Apparatus and Manufacturing Method thereof", which is hereby incorporated by reference in its entirety into this application.

BACKGROUND OF THE INVENTION

1. Technical Field

The present invention relates to a multi wireless charging apparatus and a method for manufacturing the same.

2. Description of the Related Art

A wireless charging technology is a technology of transmitting power required to wirelessly charge a battery without using a power supply code or a charging connector. The prior art has been restrictively used for an electric toothbrush, a home cordless phone, an electrically driven tool, and the like.

Recently, with an explosive increase of a smart phone market, a use of a wireless charging technology has accelerated. The smart phone enables a user to freely enjoy abundant contents and multimedia any time, but has a short use time due to a limitation of battery capacity. The environment of the wireless charging technology in a smart phone market has been greatly changed with the appearance of a smart phone corresponding to wireless charging since 2010 and products with a wireless charging module for the purpose of wirelessly charging a mobile phone and a smart phone have been continuously published at home and abroad from 2011.

Since a wireless power consortium (WPC) for expanding a contactless type standard published a first standard specification for devices having an output of 5 W or less in July, 2010, industries have continuously joined the WPC to regularly employ consistent standards in the industry. The wireless charging technology of which the market has been expanded due to an adoption of a smart phone is expected to be used for devices having a large output such as a digital camera, a tablet PC, a monitor, a digital TV, and the like, in the future.

An electromagnetic induction type that is excellent in terms of commercialization and practical use among several technologies capable of implementing wireless charging uses electromagnetic energy coupling generated between coils wound several times, as described in Korean Patent Laid-Open Publication No. 2010-0094197 (laid-open published on Aug. 26, 2010).

This is implemented as products on the basis of a Faraday's law by which electromagnetic field generated by coils in which AC or high frequency current flows generates electromotive force at output terminals of adjacent coils. When a general mobile phone, a smart phone, a digital camera, a tablet PC, a monitor, a notebook, and the like, in which a wireless charging receiving module is mounted is disposed on a charging surface of a wireless charger in which a wireless charging transmitting module is mounted, an analog circuit and a power circuit performing a charging function, a control circuit, a rectifying circuit, a charging circuit, and the like, are operated to charge a battery mounted in a device.

However, the wireless charging apparatus has a large volume and therefore, cannot be easily stored and carried, such that, it is difficult to wirelessly charge a plurality of devices simultaneously.

SUMMARY OF THE INVENTION

The present invention has been made in an effort to provide a multi wireless charging apparatus having a slim thickness so as to be rolled up in a roll form.

Further, the present invention has been made in an effort to provide a method for manufacturing a multi wireless charging apparatus.

According to a preferred embodiment of the present invention, there is provided a multi wireless charging apparatus including: a control unit wholly controlling a multi wireless charging process; and a plurality of wireless charging units electrically connected with the control and deformed into a roll form by being bonded to be provided with a plurality of interlayer voids at the time of laminating a plurality of flexible substrates.

Each of the wireless charging units may be further provided with shielding layers made of a flexible conductive material and formed on lower surfaces of the plurality of flexible substrates so as to shield electromagnetic field.

The flexible conductive material may be any one of a conductive paste, conductive coating, and a conductive sheet.

Each of the wireless charging units may include a plurality of double-sided flexible copper clad laminates (FCCL) having circuit layers formed on upper surfaces or lower surfaces thereof; and an adhesive layer in which an adhesive is separately disposed into the corresponding area to be provided with a plurality of interlayer voids by bonding only portions at which layers are electrically connected with each other at the time of laminating the plurality of double-sided FCCLs.

The adhesive may be a flexible adhesive.

The flexible adhesive may be a prepreg in which a semi hardening resin is impregnated in a glass fiber.

Each of the circuit layers may include: coil patterns formed in a continuous closed loop and having first ends disposed inside the closed loop and second ends disposed outside the closed loop; first electrode patterns spaced apart from the first ends and disposed outside the closed loop of the coil patterns; and second electrode patterns correspondingly spaced apart from the first electrode patterns and disposed outside the closed loop of the coil patterns, wherein the second ends are integrally formed with the second electrode patterns.

The adhesive layer may bond the plurality of double-sided FCCLs by disposing the adhesive so as to correspond to a portion at which the first ends, the first electrode patterns, and the second electrode patterns integrally formed with the second ends that are formed on the plurality of double-sided FCCLs, respectively, are disposed, for interlayer connection of the plurality of double-sided FCCLs.

Each of the wireless charging units may further include: a first conductive via hole formed to electrically interlayer-connect the first ends of each layer bonded by the adhesive on the plurality of double-sided FCCLs; a second conductive via hole formed to electrically interlayer-connect the first electrode patterns of each layer bonded by the adhesive on the plurality of double-sided FCCLs; a third conductive via hole formed to electrically interlayer-connect the second electrode patterns integrally formed with the second ends bonded by the adhesive on the plurality of double-sided FCCLs; and a wiring layer formed by crossing the first and second conductive via holes so as to connect between the first and second conductive via holes on an outer layer of the uppermost double-sided FCCL among the plurality of double-sided FCCLs.

Each of the wireless charging units may further include a cover layer covering an upper surface of the uppermost double-sided FCCL or a lower surface of the lowest double-sided FCCL among the plurality of double-sided FCCLs.

The cover layer may be an insulating layer made of a flexible material that is bonded by a flexible adhesive.

According to another preferred embodiment of the present invention, there is provided a method for manufacturing a multi wireless charging apparatus, including: (A) forming a plurality of wireless charging units deformed into a roll form by being bonded to be provided with a plurality of interlayer voids at the time of laminating a plurality of flexible substrates; and (B) forming a control unit electrically connected with the plurality of wireless charging units to wholly control multi charging of the plurality of wireless charging units.

The step (A) may include: (A1) preparing a plurality of double-sided FCCLs having a circuit layer formed on an upper surface or a lower surface thereof; (A2) compressing the plurality of double-sided FCCLs using an adhesive separately disposed into the corresponding area as an intermediate medium to be provided with a plurality of interlayer voids by bonding only portions at which layers are electrically connected with each other at the time of laminating the plurality of double-sided FCCLs; (A3) forming a plurality of conductive via holes for electrically interlayer-connecting portions bonded by the adhesive on the plurality of compressed double-sided FCCLs and forming a wiring layer on an outer layer of the uppermost double-sided FCCL among the plurality of double-sided FCCLs so that some of the conductive via holes are electrically connected with each other; and (A4) forming a cover layer covering outer surfaces of the plurality of double-sided FCCLs.

In the step (A1), each of the circuit layers may be formed by including: (A1-1) forming coil patterns formed in a continuous closed loop and having first ends disposed inside the closed loop and second ends disposed outside the closed loop; (A1-2) forming first electrode patterns spaced apart from the first ends and disposed outside the closed loop of the coil patterns; and (A1-3) forming second electrode patterns correspondingly spaced apart from the first electrode patterns and disposed outside the closed loop of the coil patterns, wherein the second ends are integrally formed with the second electrode patterns.

In the step (A2), the adhesive layer may be formed by including: (A2-1) disposing the adhesive so as to correspond to a portion at which the first ends, the first electrode patterns, and the second electrode patterns integrally formed with the second ends that are formed on the plurality of double-sided FCCLs, respectively, are disposed, for interlayer connection of the plurality of double-sided FCCLs; and (A2-2) compressing and adhering the plurality of double-sided FCCLs and the adhesive.

The step (A3) may include: (A3-1) forming a first conductive via hole for electrically interlayer-connecting the first ends of each layer bonded by the adhesive on the plurality of double-sided FCCLs; (A3-2) forming a second conductive via hole for electrically interlayer-connecting the first electrode patterns of each layer bonded by the adhesive on the plurality of double-sided FCCLs; (A3-3) forming a third conductive via hole for electrically interlayer-connecting the second electrode patterns integrally formed with the second ends bonded by the adhesive on the plurality of double-sided FCCLs; and (A3-4) forming a wiring layer crossing the first and second conductive via holes so as to connect between the first and second conductive via holes on a part of the upper surface of the uppermost double-sided FCCL among the plurality of double-sided FCLLs.

The step (A4) may include: (A4-1) forming a first insulating layer made of a flexible insulating material so as to protect the circuit formed on the upper surface of the uppermost double-sided FCCL among the plurality of double-sided FCCLs and prevent the circuit from being oxidized; (A4-2) forming a second insulating layer made of a flexible insulating material so as to protect the circuit formed on the lower surface of the lowest double-sided FCCL among the plurality of double-sided FCCLs and prevent the circuit from being oxidized; and (A4-3) forming a shielding layer made of a flexible conductive material on an outer surface of the second insulating layer so as to shield electromagnetic field for each area of the wireless charging part.

The flexible conductive material may be any one of a conductive paste, conductive coating, and a conductive sheet.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other objects, features and advantages of the present invention will be more clearly understood from the following detailed description taken in conjunction with the accompanying drawings, in which:

FIGS. **1**A and **1**B are a top view and a side view of a multi wireless charging apparatus according to a preferred embodiment of the present invention;

FIG. **2** is a side view illustrating a state in which the multi wireless charging apparatus according to the preferred embodiment of the present invention is rolled up in a roll form;

FIG. **3**A is a top perspective view of the multi wireless charging apparatus according to the embodiment of the present invention and FIG. **3**B is a cross-sectional view illustrating a cross section taken along the line A-A' of FIG. **3**A;

FIGS. **4**A to **4**G are diagrams for describing a method for manufacturing a multi wireless charging apparatus according to another preferred embodiment of the present invention; and

FIG. **5** is a block diagram for describing a function of a multi wireless charging apparatus according to the preferred embodiment of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The above and other objects, features and advantages of the present invention will be more clearly understood from preferred embodiments and the following detailed description taken in conjunction with the accompanying drawings. In the specification, in adding reference numerals to components throughout the drawings, it is to be noted that like reference numerals designate like components even though components are shown in different drawings. Further, when it is determined that the detailed description of the known art related to the present invention may obscure the gist of the present invention, the detailed description thereof will be omitted. In the description, the terms "first", "second", and so on are used to distinguish one element from another element, and the elements are not defined by the above terms.

Hereinafter, preferred embodiments of the present invention will be described in detail with reference to the accompanying drawings.

FIGS. **1**A and **1**B are a top view and a side view of a multi wireless charging apparatus according to a preferred embodiment of the present invention and FIG. **2** is a side view illustrating a state in which the multi wireless charging apparatus according to the preferred embodiment of the present invention is rolled up in a roll form.

For example, as illustrated in FIGS. **1**A and **1**B, a multi wireless charging apparatus **100** according to a preferred embodiment of the present invention includes, for example, a control unit **101** that wholly controls a multi wireless charging process, a plurality of wireless charging units **110** to **150** that are electrically connected with the control unit **101** and are bonded to include a plurality of interlayer voids at the time of laminating a plurality of flexible substrates to be deformed into a roll form, for example, a first wireless charging unit **110** electrically connected with the control unit **101**, a second wireless charging unit **120** electrically connected with the control unit **101** and extendedly connected with the first wireless charging unit **110** at a predetermined distance, a third wireless charging unit **130** that is electrically connected with the control unit **101** and extendedly connected with the second wireless charging unit **120** at a predetermined distance, a fourth wireless charging unit **140** that is electrically connected with the control unit **101** and extendedly connected with the third wireless charging unit **130** at a predetermined distance, and a fifth wireless charging unit **150** that is electrically connected with the control unit **101** and extendedly connected with the fourth wireless charging unit **140** at a predetermined distance.

In addition, the multi wireless charging apparatus **100** according to the preferred embodiment of the present invention may be configured to further include a plurality of wireless charging units that are extendedly connected with the fifth wireless charging unit **150** at a predetermined distance.

The multi wireless charging apparatus **100** includes shielding layers **171** disposed on lower surfaces of each of the first wireless charging unit **110** to the fifth wireless charging unit **150** to shield electromagnetic field and wireless charging receivers **200** and **300** such as a smart phone, a mobile communication terminal, and the like, to be wirelessly charged are disposed on upper surfaces of each of the first wireless charging unit **110** to the fifth wireless charging unit **150**.

Hereinafter, an internal structure of the multi wireless charging apparatus **100** according to the preferred embodiment of the present invention will be described with reference to FIGS. **3**A to **3**B. FIG. **3**A is a top perspective view of the multi wireless charging apparatus according to the embodiment of the present invention and FIG. **3**B is a cross-sectional view illustrating a cross section taken along the line A-A' of FIG. **3**A.

In the internal structure of the multi wireless charging apparatus **100** according to the preferred embodiment of the present invention, as illustrated in FIG. **3**A, the control unit **101** include a plurality of circuits and elements and each of the first wireless charging unit **110** to the fifth wireless charging unit **150** includes coil patterns that are connected with each driver **103** (see FIG. **5**) mounted in the control unit **101** and extendedly provided.

In addition, as illustrated in FIG. **3**B taken along the line A-A' of FIG. **3**A, the internal structures of each of the first wireless charging unit **110** to the fifth wireless charging unit **150** of the multi wireless charging apparatus **100** are the same and include each interlayer void **161**.

In detail, each of the first wireless charging unit **110** to the fifth wireless charging unit **150** includes a plurality of double-sided flexible copper clad laminates (FCCLs) **10** and **12** including circuit layers **12'**, **22'**, **13'** and **23'** on upper surfaces **12** and **22** or lower surfaces **13** and **23** and includes an adhesive layer **30** in which an adhesive is separately disposed into the corresponding area to be provided with a plurality of interlayer voids **161** by bonding only portions at which layers are electrically connected with each other at the time of laminating the plurality of double-sided FCCLs.

Each circuit layer **12'**, **22'**, **13'** and **23'** have coil patterns **13-1**, **22-1**, and **23-1** formed of a plurality of continuous closed loops that are formed on lower surfaces **13** and **23** or upper surfaces **12** and **22** of the double-sided FCCLs **10** and **20**. In this case, first ends **13-2**, **22-2**, and **23-2** of the coil patterns **13-1**, **22-1**, and **23-1** are disposed inside the closed loop and second ends (not illustrated) of the coil patterns **13-1**, **22-1**, and **23-1** is disposed outside the closed loop.

Further, first electrode patterns **13-3**, **22-3**, and **23-3** to be electrically connected with the first ends **13-2**, **22-2**, and **23-2** are disposed outside a closed loop of the coil patterns **13-1**, **22-1**, and **23-1** so as to be spaced apart from the first ends **13-2**, **22-2**, and **23-2** and second electrode patterns (not illustrated) to be electrically connected with the second ends (not illustrated) are disposed outside the closed loop of the coil patterns **13-1**, **22-1**, and **23-1** so as to be correspondingly spaced apart from the first ends **13-2**, **22-2**, and **23-2**. In this case, the second ends (not illustrated) are integrally formed with the second electrode patterns (not illustrated).

As such, the plurality of double-sided FCCLs **10** and **20** on which each circuit layer **12'**, **22'**, **13'**, and **23'** are formed are bonded to each other by the adhesive layer **30** for interlayer connection.

The adhesive layer **30** bonds the plurality of double-sided FCCLs **10** and **20** by disposing the adhesive so as to correspond to a portion at which the first ends **13-2**, **22-2**, and **23-2**, the first electrode patterns **13-3**, **22-3**, and **23-3**, and the second electrode patterns (not illustrated) integrally formed with the second ends are disposed.

Here, as the adhesive, a flexible adhesive may be used. An example of the flexible adhesive may include a prepreg in which a semi hardening resin is impregnated in a glass fiber.

Next, each wireless charging unit **110** to **150** includes a first conductive via hole H**1** formed by a drilling method, and the like, so as to electrically interlayer-connect the first ends **13-2**, **22-2**, and **23-2** of each layer bonded by the adhesive layer **30** on the plurality of double-sided FCCLs **10** and **20**, a second conductive via hole H**2** formed so as to electrically interlayer-connect the first electrode patterns **13-3**, **22-3**, and **23-3** of each layer bonded by the adhesive layer **30** on the plurality of double-sided FCCLs **10** and **20**, and a third conductive via hole (not illustrated) formed so as to electrically interlayer-connect the second electrode patterns (not illustrated) integrally formed with the second ends bonded by the adhesive layer **30** on the plurality of double-sided FCCLs **10** and **20**.

In addition, an outer layer of the uppermost double-sided FCCL **10** of the plurality of double-sided FCCLs **10** and **20** is provided with a wiring layer **41'** formed by crossing the first and second conductive via holes H**1** and H**2** so as to connect between the first and second conductive via holes H**1** and H**2**.

In addition, each wireless charging unit **110** to **150** may further include a cover layer **60** formed so as to cover an upper surface of the uppermost double-sided FCCL **10** or a lower surface of a lowest double-sided FCCL **20** of the plurality of double-sided FCCLs **10** and **20**, thereby protecting the wiring layer **41'** and the circuit layers **12'**, **22'**, **13'**, and **23'**. In this case, the cover layer **60** is formed of an insulating layer that is made of a flexible material and is bonded by a flexible adhesive **50**.

Further, each wireless charging unit **110** to **150** may further include a shielding layer **171** made of a flexible conductive material that is formed on the lower surface of the lowest double-sided FCCL **20** of the plurality of double-sided FCCLs **10** and **20**, thereby shielding an electromagnetic field. In this case, an example of the flexible conductive material may include any one of a conductive paste, conductive coating, and a conductive sheet.

The plurality of wireless charging units **110** to **150** according to the embodiment of the present invention configured as described above can be implemented in a folding or roll form as in FIG. **2** by bonding only a minimum area of the flexible substrates using the adhesive layer **30** to be provided with the plurality of interlayer voids at the time of laminating the plurality of flexible substrates.

In addition, the shielding between respective wireless charging units **110** to **150** is made by the shielding layer **171**, such that the reliability of wireless charging of the wireless charging unit **110** to **150** can be improved.

Here, the multi wireless charging apparatus **100** according to the preferred embodiment of the present invention uses the two double-sided FCCLs **10** and **20**, but the preferred embodiment of the present invention is not limited thereto. Therefore, the multi wireless charging apparatus **100** may be formed so that the plurality of circuit layers are laminated using the plurality of double-sided FCCLs.

Hereinafter, a method for manufacturing a multi wireless charging apparatus according to another preferred embodiment of the present invention will be described with reference to FIGS. **4**A to **4**G. FIGS. **4**A to **4**G are cross-sectional views sequentially describing the process of a method for manufacturing a wireless charging apparatus according to another preferred embodiment of the present invention and are diagrams illustrated based on the line A-A' of FIG. **3**.

The method for manufacturing a multi wireless charging apparatus **100** according to another preferred embodiment of the present invention includes the double-sided FCCL **10** and **20** formed by laminating first copper foils **12** and **22** on upper surfaces of first insulating layers **11** and **21** made of thermoplastic materials such as polyimide, and the like, and laminating second copper foils **13** and **23** on lower surfaces of the first insulating layers **11** and **21**, as illustrated in FIG. **4**A.

After the double-sided FCCLs **10** and **20** are prepared, as illustrated in FIG. **4**B, the predetermined circuit layers **12'**, **22'**, **13'**, and **23'** are formed on any one surface or both surfaces of the first copper foils **12** and **22** and the second copper foils **13** and **23** of each of the double-sided FCCLs **10** and **20** for each area of each of first wireless charging unit **110** to the fifth wireless charging unit **150**.

For example, the second copper foil **13** of the first double-sided FCCL **10** is provided with the first circuit layer **13'** including the coil pattern **13-1**, the first end **13-2** of the coil pattern **13-1**, and the first electrode pattern **13-3** that are formed in a plurality of continuous closed loops.

Similarly, the first copper foil **22** of the second double-sided FCCL **20** is provided with the second circuit layer **22'** corresponding to the first circuit layer **13'** and including the coil pattern **22-1**, the first end **22-2** of the coil pattern **22-1**, and the first electrode pattern **22-3** that are formed in a plurality of continuous closed loops.

Here, the first and second circuit layers **13'** and **22'** are each provided with the second electrode patterns (not illustrated) of each layer that are integrally formed with the second ends (not illustrated) of the coil patterns **13-1** and **22-1** of each layer.

In this case, the first ends **13-2** and **22-2** are disposed inside the closed loop and the second ends (not illustrated) are disposed outside the closed loop.

Next, as illustrated in FIG. **4**C, in the first double-sided FCCL **10** and the second double-sided FCCL **20**, the first circuit layer **13'** corresponds to the second circuit layer **22'** and the adhesive layers **30** are each disposed between the first double-sided FCCL **10** and the second double-sided FCCL **20** for each area of the first wireless charging unit **110** to the fifth wireless charging unit **150**.

In this case, the adhesive layers **30** are disposed only at the portions at which layers are electrically connected with each other, that is, the portions at which the first ends **13-2**, **22-2**, and **23-2**, the first electrode patterns **13-3**, **22-3**, and **23-3**, and the second electrode patterns (not illustrate) integrally formed with the second ends are formed.

The first double-sided FCCL **10** and the second double-sided FCCL **20** are thermally compressed by the adhesive layer **30** disposed as above and thus, are formed to have a laminated structure as illustrated in FIG. **4**D.

Using the plurality of double-sided FCCLs of which any one surface or both surfaces are provided with the circuit layers by the foregoing method, it is possible to easily form the coil patterns formed in a plurality of closed loops. In addition, the overall thickness of the multi wireless charging apparatus can be slimmed by including the adhesive layer **30** only in some areas by the thermo compression process and the plurality of interlayer voids **161** may be provided between the plurality of double-sided FCCLs **10** and **20**.

Next, for the laminated double-sided FCCLs **10** and **20**, the first conductive via holes H**1** for electrical interlayer connection of the first ends **13-2** and **22-2** formed on the circuit layers **13'** and **22'** and the second conductive via hole H**2** for interlayer connection of the first electrode patterns **13-3** and **22-3** are provided.

Here, the first and second conductive via holes H**1** and H**2**, which are a plated through hole (PTH), are formed by a mechanical drilling process such as computerized numerical control (CNC) drilling, and the like.

Although not illustrated, a third metal via hole (not illustrated) for electrical interlayer connection of the second electrode patterns (not illustrated) integrally formed with the second ends of each layer may be formed by a similar method.

When the first and second conductive via holes H**1** and H**2** formed by the drilling process are plated with conductive metals, as illustrated in FIG. **4**D, the inside of the first and second conductive via holes H**1** and H**2** are filed with conductive metals and a plating layer **40** covering the outer surfaces of the double-sided FCCLs **10** and **20** is formed.

Next, the wiring pattern **41'** crossing from the first conductive via hole H**1** to the second conductive via hole H**2** is formed by etching the upper portion of the plating layer **40** and the external copper foil **12** so as to electrically connect the first ends **13-2** with the first electrode patterns **13-3** and **22-3**, as illustrated in FIG. **4**E.

Next, in order to protect the exposed circuit including the wiring pattern **41'** and prevent the exposed circuit from being oxidized, the exposed surface of the upper insulating layer **11** and the exposed surface of the lower insulating layer **21** including the wiring pattern **41'** are subjected to a coverlay process forming the cover layer **60** using the flexible adhesive **50**.

That is, the first insulating layer is made of a flexible insulating material for protecting the circuit layer formed on the upper surface of the uppermost double-sided FCCL **10** of the plurality of double-sided FCCLs **10** and **20** and preventing the circuit layer from being oxidized and a second insulating layer is made of a flexible insulating material for protecting the circuit layer formed on the lower surface of the lowest double-sided FCCL **20** of the plurality of double-sided FCCLs **10** and **20** and preventing the circuit layer from being oxidized. In this case, an example of the flexible conductive material may include any one of a conductive paste, conductive coating, and a conductive sheet.

The coverlay process, which is a process for protecting and insulating the uppermost and lowest exposed surfaces of the etched double-sided FCCL, can be applied to a fine circuit by making heat-resistant adhesion, electric insulation, flame resistance, elasticity, and flow of an adhesive uniform.

In the foregoing coverlay process, a compressing process may be performed in the state in which the shielding layer is formed on the upper surface of the insulating layer **60** or a process of forming the shielding layer **171** may be separately performed.

Therefore, as illustrated in FIG. **4**G, the shielding layer **171** is formed on the lower surface of the insulating layer **60** for each area of the first wireless charging unit **110** to the fifth wireless charging unit **150**.

The shielding layer **171** may be made of conductive materials such as conductive paste, ferrite, and the like.

Next, for the control units **101** connected with each wireless charging unit **110** to **150**, elements (not illustrated) configuring the control unit **101** are mounted in the area of the control unit **101**.

The method for manufacturing a multi wireless charging apparatus according to another preferred embodiment of the present invention as described above easily forms the structure in which the coil patterns are laminated using the double-sided FCCLs **10** and **20**, the overall thickness of the multi wireless charging apparatus **100** is slimmed, and can implement the plurality of wireless charging units **110** to **150** in the folding or roll form by including the interlayer voids **161**.

Hereinafter, a function of the multi wireless charging apparatus according to the preferred embodiment of the present invention that is manufactured as described above will be described with reference to FIG. **5**. FIG. **5** is a block diagram for describing a function of a multi wireless charging apparatus according to the preferred embodiment of the present invention.

The multi wireless charging apparatus **100** according to the preferred embodiment of the present invention may include a plurality of wireless charging units **110**, **120**, . . . **1*n*0** including the first wireless charging unit **110** to the fifth wireless charging units **150** illustrated in FIG. **1** and the control unit **101** controlling the wireless power transmission of the plurality of wireless charging units **110**, **120**, . . . , **1*n*0**.

In particular, the control unit **101** is configured to include a main controller **102**, a plurality of drivers **103** each driving the plurality of wireless charging units **110**, **120**, . . . , **1*n*0** according to the control signal from the main controller **102**, a detector **104** detecting information on whether wireless charging receivers **200-1**, . . . , **200-*n*** are located corresponding to the wireless charging units **110**, **120**, . . . , **1*n*0**, and a comparator **105** comparing current and voltage detected by the detector **104** to determine whether the detected current and voltage is larger than a set value.

In the multi wireless charging apparatus **100**, the comparator **105** determines that the receivers **200-1**, . . . , **200-*n*** are present when the current and voltage detected by the detector **104** are larger than the set value and can simultaneously charge wirelessly the plurality of wireless charging receivers **200-1**, . . . , **200-*n*** that are located corresponding to the wireless charging units **110**, **120**, . . . , **1*n*0**, respectively.

Further, when the multi wireless charging apparatus **100** performs the wireless charging in the overlapping state illustrated in FIG. **3**A or **3**B, the multi wireless charging apparatus **100** may perform the wireless power transmission without the mutual interference due to the shielding layer **171** formed on the lower surfaces of the wireless charging units **110**, **120**, . . . , **1*n*0**.

Therefore, the multi wireless charging apparatus according to the preferred embodiment of the present invention can simultaneously charge wirelessly the plurality of wireless charging receivers and perform the wireless power transmission without the mutual interference due to the shielding by the shielding layer.

Further, the multi wireless charging apparatus according to the preferred embodiment of the present invention can be overlappingly integrated in various forms due to the folding part the while having a slim thickness and therefore, can be conveniently carried.

The multi wireless charging apparatus according to the preferred embodiments of the present invention can wirelessly charge the plurality of wireless charging receivers simultaneously and form the shielding by the shielding layer to perform the wireless power transmission without mutual interference.

In addition, the multi wireless charging apparatus according to the preferred embodiments of the present invention can be rolled up in a roll form while having a slim thickness and therefore, can be conveniently carried.

Although the embodiments of the present invention have been disclosed for illustrative purposes, it will be appreciated that the present invention is not limited thereto, and those skilled in the art will appreciate that various modifications, additions and substitutions are possible, without departing from the scope and spirit of the invention.

Accordingly, any and all modifications, variations or equivalent arrangements should be considered to be within the scope of the invention, and the detailed scope of the invention will be disclosed by the accompanying claims.

What is claimed is:

1. A multi wireless charging apparatus, comprising:

a controller wholly controlling a multi wireless charging process; and

a plurality of wireless charging units electrically connected with the control and deformed into a roll form by having layers bonded together at which the layers are electrically connected with each other so as to be provided with a plurality of interlayer voids at the time of laminating a plurality of flexible substrates, each of the wireless charging units comprising

a plurality of double-sided flexible copper clad laminates (FCCLs) having circuit layers formed on upper surfaces or lower surfaces thereof,

an adhesive layer in which an adhesive is separately disposed into a corresponding area to be provided with the plurality of interlayer voids by bonding only portions at which layers are electrically connected with each other at the time of laminating the plurality of double-sided FCCLs, and

a plurality of conductive via holes formed so as to electrically interlayer-connect the portions bonded by the adhesive on the plurality of double-sided FCCLs.

2. The multi wireless charging apparatus as set forth in claim **1**, wherein each of the wireless charging units is further provided with shielding layers made of a flexible conductive material and formed on lower surfaces of the plurality of flexible substrates so as to shield electromagnetic field.

3. The multi wireless charging apparatus as set forth in claim **2**, wherein the flexible conductive material is any one of a conductive paste, conductive coating, and a conductive sheet.

4. The multi wireless charging apparatus as set forth in claim **1**, wherein the adhesive is a flexible adhesive.

5. The multi wireless charging apparatus as set forth in claim **4**, wherein the flexible adhesive is a prepreg in which a semi hardening resin is impregnated in the flexible adhesive.

6. The multi wireless charging apparatus as set forth in claim **1**, wherein each of the circuit layers includes:

coil patterns formed in a continuous closed loop and having first ends disposed inside the closed loop and second ends disposed outside the closed loop;

first electrode patterns spaced apart from the first ends and disposed outside the closed loop of the coil patterns; and second electrode patterns correspondingly spaced apart from the first electrode patterns and disposed outside the closed loop of the coil patterns, and

wherein the second ends are integrally formed with the second electrode patterns.

7. The multi wireless charging apparatus as set forth in claim **6**, wherein the adhesive layer bonds the plurality of double-sided FCCLs by disposing the adhesive so as to correspond to a portion at which the first ends, the first electrode patterns, and the second electrode patterns integrally formed with the second ends that are formed on the plurality of double-sided FCCLs, respectively, are disposed, for interlayer connection of the plurality of double-sided FCCLs.

8. The multi wireless charging apparatus as set forth in claim **7**, wherein each of the wireless charging units further includes:

a first conductive via hole formed to electrically interlayer-connect the first ends of each layer bonded by the adhesive on the plurality of double-sided FCCLs;

a second conductive via hole formed to electrically interlayer-connect the first electrode patterns of each layer bonded by the adhesive on the plurality of double-sided FCCLs;

a third conductive via hole formed to electrically interlayer-connect the second electrode patterns integrally formed with the second ends bonded by the adhesive on the plurality of double-sided FCCLs; and

a wiring layer formed by crossing the first and second conductive via holes so as to connect between the first and second conductive via holes on an outer layer of the uppermost double-sided FCCL among the plurality of double-sided FCCLs.

9. The multi wireless charging apparatus as set forth in claim **8**, wherein each of the wireless charging units further includes a cover layer covering an upper surface of the uppermost double-sided FCCL or a lower surface of the lowest double-sided FCCL among the plurality of double-sided FCCLs.

10. The multi wireless charging apparatus as set forth in claim **9**, wherein the cover layer is an insulating layer made of a flexible material that is bonded by a flexible adhesive.

11. A method for manufacturing a multi wireless charging apparatus, comprising:

forming a plurality of wireless charging units deformed into a roll form by having layers bonded together at which the layers are electrically connected with each other so as to be provided with a plurality of interlayer voids at the time of laminating a plurality of flexible substrates; and

forming a controller electrically connected with the plurality of wireless charging units to wholly control multi charging of the plurality of wireless charging units, wherein the forming of the plurality of wireless charging units comprises

preparing a plurality of double-sided FCCLs having a circuit layer formed on an upper surface or a lower surface thereof,

compressing the plurality of double-sided FCCLs using an adhesive separately disposed into a corresponding area as an intermediate medium to be provided with the plurality of interlayer voids by bonding only portions at which layer are electrically connected with each other at the time of laminating the plurality of double sided FCCLs,

forming a plurality of conductive via holes for electrically interlayer-connecting portions bonded by the adhesive on the plurality of compressed double-sided FCCLs and forming a wiring layer on an outer layer of an uppermost double-sided FCCL among the plurality of double-sided FCCLs so that some of the conductive via holes are electrically connected with each other, and

forming a cover layer covering outer surfaces of the plurality of the double-sided FCCLs.

12. The method as set forth in claim **11**, wherein in the preparing the plurality of double-sided FCCLs, each of the circuit layers is formed by:

forming coil patterns formed in a continuous closed loop and having first ends disposed inside the closed loop and second ends disposed outside the closed loop;

forming first electrode patterns spaced apart from the first ends and disposed outside the closed loop of the coil patterns; and

forming second electrode patterns correspondingly spaced apart from the first electrode patterns and disposed outside the closed loop of the coil patterns, and

wherein the second ends are integrally formed with the second electrode patterns.

13. The method as set forth in claim **12**, wherein in the compressing the plurality of double-sided FCCLs, the adhesive layer is formed by:

disposing the adhesive so as to correspond to a portion at which the first ends, the first electrode patterns, and the second electrode patterns integrally formed with the second ends that are formed on the plurality of double-sided FCCLs, respectively, are disposed, for interlayer connection of the plurality of double-sided FCCLs; and

compressing and adhering the plurality of double-sided FCCLs and the adhesive.

14. The method as set forth in claim **13**, wherein the forming the plurality of conductive via holes includes:

forming a first conductive via hole for electrically interlayer-connecting the first ends of each layer bonded by the adhesive on the plurality of double-sided FCCLs;

forming a second conductive via hole for electrically interlayer-connecting the first electrode patterns of each layer bonded by the adhesive on the plurality of double-sided FCCLs;

forming a third conductive via hole for electrically interlayer-connecting the second electrode patterns integrally formed with the second ends bonded by the adhesive on the plurality of double-sided FCCLs; and

forming a wiring layer crossing the first and second conductive via holes so as to connect between the first and second conductive via holes on a part of the upper surface of the uppermost double-sided FCCL among the plurality of double-sided FCCLs.

15. The method as set forth in claim **14**, wherein the forming the cover layer includes:

forming a first insulating layer made of a flexible insulating material so as to protect the circuit formed on the upper surface of the uppermost double-sided FCCL among the plurality of double-sided FCCLs and prevent the circuit from being oxidized;

forming a second insulating layer made of a flexible insulating material so as to protect the circuit formed on the lower surface of the lowest double-sided FCCL among the plurality of double-sided FCCLs and prevent the circuit from being oxidized; and

forming a shielding layer made of a flexible conductive material on an outer surface of the second insulating layer so as to shield electromagnetic field for each area of the wireless charging part.

16. The method as set forth in claim **15**, wherein the flexible conductive material is any one of a conductive paste, conductive coating, and a conductive sheet.

17. A multi wireless charging apparatus, comprising:

a controller wholly controlling a multi wireless charging process; and

a plurality of wireless charging units electrically connected with the control and deformed into a roll form by being bonded to be provided with a plurality of interlayer voids at the time of laminating a plurality of flexible substrates, each of the wireless charging units including

a plurality of double-sided flexible copper clad laminates (FCCL) having circuit layers formed on upper surfaces or lower surfaces thereof,

an adhesive layer in which an adhesive is separately disposed into the corresponding area to be provided with a plurality of interlayer voids by bonding only portions at which layers are electrically connected with each other at the time of laminating the plurality of double-sided FCCLs, each of the circuit layers including

coil patterns formed in a continuous closed loop and having first ends disposed inside the closed loop and second ends disposed outside the closed loop,

first electrode patterns spaced apart from the first ends and disposed outside the closed loop of the coil patterns, and

second electrode patterns correspondingly spaced apart from the first electrode patterns and disposed outside the closed loop of the coil patterns, and wherein the second ends are integrally formed with the second electrode patterns,

wherein the adhesive layer bonds the plurality of double-sided FCCLs by disposing the adhesive so as to correspond to a portion at which the first ends, the first electrode patterns, and the second electrode patterns integrally formed with the second ends that are formed on the plurality of double-sided FCCLs, respectively, are disposed, for interlayer connection of the plurality of double-sided FCCLs, and

each of the wireless charging units further including

a first conductive via hole formed to electrically interlayer-connect the first ends of each layer bonded by the adhesive on the plurality of double-sided FCCLs,

a second conductive via hole formed to electrically interlayer-connect the first electrode patterns of each layer bonded by the adhesive on the plurality of double-sided FCCLs,

a third conductive via hole formed to electrically interlayer-connect the second electrode patterns integrally formed with the second ends bonded by the adhesive on the plurality of double-sided FCCLs, and

a wiring layer formed by crossing the first and second conductive via holes so as to connect between the first and second conductive via holes on an outer layer of the uppermost double-sided FCCL among the plurality of double-sided FCCLs.

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